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SIXTEENTH ANNUAL REPORT
YELLOWSTONE RIVER COMPACT COMMISSION
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SIXTEENTH ANNUAL REPORT
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YELLOWSTONE RIVER COMPACT COMMISSION

421 Federal Building
Helena, Montana

December 1967

Honorable Stanley K. Hathaway
Governor of the State of Wyoming
Cheyenne, Wyoming

Honorable Tim M. Babcock
Governor of the State of Montana
Helena, Montana

Honorable William L. Guy
Governor of the State of North Dakota
Bismarck, North Dakota

Sirs:

Pursuant to Article III of the Yellowstone River Compact, the Commission makes the following sixteenth annual report of activities for the period ending September 30, 1967.

The sixteenth annual meeting of the Commission was held in Sheridan, Wyoming on December 19, 1967. Mr. Floyd A. Bishop, Wyoming State Engineer and Mr. Everett V. Darlinton, Director, Montana Water Resources Board, the designated representatives of their respective states, were present. Mr. Harlan M. Erskine, designated federal representative, served as chairman and secretary. Others present were: T. E. Cahill, Attorney General's Office, Wyoming; Paul Kawvlok, State Engineer's Office, Wyoming; William Long and Kenneth Bower, State Board of Control, Wyoming; P. E. Madsen, State Legislature, Wyoming; Carl Bergner, Northern Wyoming Land Co.; C. R. Oslund, Sheridan, Wyoming; Don Sullivan, J. R. Harrison, Jr., T. P. McNulty, and C. L. Hawks, Montana Water Resources Board; H. S. Riesbol, R. C. Harlan and W. P. Henry, Bechtel Corporation, San Francisco; C. T. Judah and P. Q. Gibbs, Bureau of Reclamation, Billings; and C. W. Lane and G. M. Pike, U. S. Geological Survey, Montana District.

During the year ending September 30, 1967, annual streamflow at the designated points of measurement in Montana ranged from 128 to 162 percent of the 1945-60 averages. Irrigation needs were supplied satisfactorily. Storage in the major reservoirs increased substantially during the year with the volume in storage on September 30, 1967 ranging from 107 to 262 percent of the contents one year earlier.

There were no developments during the year which required allocations of water in accordance with the provisions of the Compact. The State Commissioners

are of the opinion that the present water resources development does not warrant verification or study of allocable use.

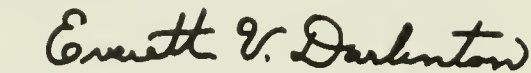
It is evident that there is much interest in possible future large industrial water supply developments from the major rivers in the Yellowstone River basin; particularly from the Tongue and the Bighorn Rivers. Montana has engaged the Bechtel Corporation, San Francisco, to make a study to establish the quantity of unused and unappropriated water in the Tongue River system which would be available for conservation and use by the Tongue River Project in Montana. The study is nearing completion. The Bureau of Reclamation has made preliminary studies of water available for allocation and use in the Bighorn River basin. Options have recently been executed between the Bureau and five large companies for the purchase of 203,000 acre-feet annually for industrial use from Bureau reservoirs in the Bighorn River basin.

The expense of the Commission during the fiscal year ending June 30, 1967 was \$9,000, and a like amount is being budgeted to cover anticipated costs during the current fiscal year.

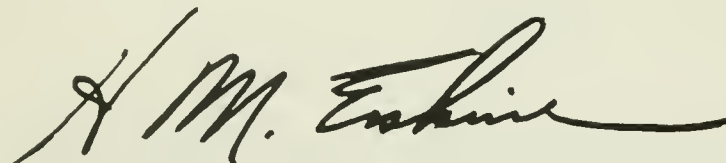
Respectfully submitted,



Floyd A. Bishop
Commissioner for Wyoming



Everett V. Darlington
Commissioner for Montana



Harlan M. Erskine
Federal Representative

GENERAL REPORT

Cost:

The work of the Commission, which to date has been primarily concerned with the collection of required hydrologic data, has been financed through cooperative arrangements whereby Montana and Wyoming each bear one-fourth of the cost and the remaining one-half is borne by the United States. The salaries and necessary expenses of the State representatives and hydrologic data made available by other agencies is not evaluated or considered as expense of the Commission.

The expense of the Commission during the fiscal year ending June 30, 1967 was \$9,000 in accordance with the budget adopted for that year.

The budget for fiscal year ending June 30, 1968 was initially arranged by earlier negotiation between the cooperating agencies and verified at the annual meeting. It is summarized as follows:

Gaging station operation and supplementary periodic measurements of discharge at auxiliary points	\$8,000
Data assembly, report preparation and secretarial functions	<u>1,000</u>
Total	\$9,000

Gaging stations:

The collection of discharge records at sites specified in the Rules and Regulations, or at a substitute site for the Clarks Fork of the Yellowstone River, was continued. The Clarks Fork of the Yellowstone River records are being collected at a gaging station at Edgar, about four miles upstream from the Whitehorse Canal diversion and six miles upstream from the mouth of Rock Creek. During the diversion season, periodic supplementary measurements were made of the flow in Whitehorse Canal and the Clarks Fork a short distance upstream from Rock Creek to establish flow relationships. The results were inconclusive.

Plans are being made to relocate the gaging station on Clarks Fork at a site a short distance above Rock Creek. This change is scheduled for 1969 fiscal year. In the meantime, the gaging station presently in use will be continued.

Streamflow at all designated points of measurement was much higher than during 1966. It ranged from 128 to 162 percent of the 1945-60 averages.

Details of streamflow and bar-graph comparisons with average flows during selected base periods are given in Appendix B.

Diversions:

Opinions expressed by the two State representatives indicated that allocable diversions in Montana and Wyoming initiated since January 1, 1950 did not warrant detailed consideration and that use in the upstream State did not exceed Compact allowances.

Mr. Darlinton reported that as a result of strong indications of future needs for large industrial water supplies in the Tongue River basin in Montana, the Montana Water Resources Board had engaged the Bechtel Corporation, San Francisco, to make a water allocation study to establish the quantity of unused and unappropriated water in the Tongue River system which would be available for conservation and use by the Tongue River Project in Montana. The study was begun last June and is expected to be completed within a few months.

Mr. Judah of the Bureau of Reclamation reported that the Bureau has recently signed separate 8-year options with five large companies who propose to purchase water totaling 203,000 acre feet annually for industrial use from the Bureau's reservoirs in the Bighorn River basin. The usage proposed is in both Wyoming and Montana. The Bureau has made a preliminary study of the water available in the Bighorn River basin for use in each state under the terms of allocation provided in the Compact.

In view of the developments indicated, the Commission is concerned with regard to the adequacy of the existing stream-flow data collection program to meet the needs when allocations must be made. A resolution was adopted requesting the U.S. Geological Survey to make a study to determine the additional stream-flow data collection needed to adequately administer the Compact, and asking that recommendations in this connection be made to the Commission by July 1, 1968.

Storage:

In reservoirs completed after January 1, 1950

Yellowtail Reservoir, a Bureau of Reclamation project on Bighorn River, filled for the first time since its completion in 1965. The maximum content was 1,365,000 acre-feet on July 6, 1967; it contained 1,071,000 acre feet on September 30, 1967. Details regarding this reservoir are given in Appendix C.

Boysen Reservoir on the Wind River, operated by the Bureau of Reclamation, was filled during the snow-melt period and reached a maximum content of 922,600 acre feet on July 7, 1967. At the end of September, it contained 742,600 acre feet. Details regarding this reservoir are given in Appendix C.

The Commission is cognizant of other reservoirs in this general group and considers their aggregate effect to be insufficient to warrant the collection of storage data at this time.

In reservoirs existing on January 1, 1950

Storage pertinent to Compact allocation in these reservoirs is confined to usage for new developments completed after January 1, 1950. This is currently considered very minor. Month-end storage data for these reservoirs is given in Appendix D as a matter of record and general information on water supply.

RULES AND REGULATIONS FOR ADMINISTRATION OF
THE YELLOWSTONE RIVER COMPACT

A compact, known as the Yellowstone River Compact between the States of Wyoming, Montana and North Dakota, having become effective on October 30, 1951 upon approval of the Congress of the United States, which apportions the waters of certain interstate tributaries of the Yellowstone River which are available after the appropriative rights existing in the States of Wyoming and Montana on January 1, 1950 are supplied, and after appropriative rights to the use of necessary supplemental water are also supplied as specified in the Compact, the following rules and regulations are adopted subject to the provisions for amendment, revision or abrogation as provided herein.

Article I. Collection of Water Records.

- A. It shall be the joint and equal responsibility of the members of the states of Wyoming and Montana to collect, cause to be collected or otherwise furnish records of tributary stream flow at the points of measurement specified in Article V (B) of the Compact, or as near thereto as is physically or economically feasible or justified.

1. Clarks Fork

The gaging station known as Clarks Fork at Edgar, Montana and which is located in SW 1/4, sec. 24, T.4 S., R.24 E., shall temporarily be the point of measurement for the Clarks Fork, subject to whatever mutually agreeable corrections to the stream-flow records at this point as may be deemed practical to meet the terms of the Compact.

2. Bighorn River (exclusive of Little Bighorn River)

The gaging station known as the Bighorn River near Custer, Montana and located near the center of sec. 10, T.4 N., R.34 E., shall temporarily be the designated point of measurement on that stream. The flow of the Little Bighorn River as measured at the gaging station near Hardin, Montana and located in S 1/2, SE 1/4 sec. 18, T.1 S., R.34 E., shall be considered the point of measurement for that stream, except that if or when satisfactory records are not available, the records for the nearest upstream station with practical corrections for intervening inflow or diversion shall be used.

3. Tongue River

The gaging station known as the Tongue River at Miles City, Montana and located in SE 1/4, sec. 23, T.7 N., R.47 E., shall temporarily be the point of measurement for that stream.

4. Powder River

The gaging station known as the Powder River near Locate, Montana and located in NE 1/4, sec. 26, T.8 N., R.51 E., shall temporarily be the designated point of measurement for that stream.

- B. Records of total annual diversion in acre-feet above the points of measurement designated in the Compact for irrigation, municipal and industrial uses developed after January 1, 1950 shall be furnished by the members of the Commission for their respective states, at such time as the Commission deems necessary for interstate administration as provided by the terms of the Compact. Providing that if it be acceptable to the Commission, reasonable estimates thereof may be substituted.
- C. Annual records of the net change in storage in all reservoirs, not excluded under Article V (E) of the Compact, above the specified point of measurement specified in the Compact and completed after January 1, 1950, and the annual net change in reservoirs existing prior to January 1, 1950, which is used for irrigation, municipal and industrial purposes developed after January 1, 1950, shall be the primary responsibility of the member of the Commission in whose state such works are located; providing, such data is not furnished by federal agencies under the provisions of Article III (D) of the Compact, or, collected by the Commission.

Article II. Office and Officers.

- A. The office of the Commission shall be located, and be that of the United States Geological Survey in Helena, Montana.
- B. The Chairman of the Commission shall be the federal representative as provided in the Compact.
- C. The Secretary of the Commission shall be as provided for in Article III of these rules.
- D. The credentials of each member of the Commission shall be placed on file in the office of the Commission.

Article III. Secretary

- A. The Commission, subject to the approval of the Director of the United States Geological Survey, shall enter into cooperative agreements with the U. S. Geological Survey for such engineering and clerical services as may reasonably be necessary for the administration of the Compact. Said agreements shall provide that the Geological Survey shall:
 - 1. Maintain and operate gaging stations at or near the points of measurement specified in Article V (A) of the Compact.
 - 2. Assemble factual information on stream flow, diversion and reservoir storage for the preparation of an annual report to the Governors of the signatory states.
 - 3. Make such investigations and reports as may be requested by the Commission in aid of its administration of the Compact.
- B. Act as Secretary to the Commission.

Article IV. Budget

- A. At the annual meeting of each even numbered year or prior thereto, the Commission shall adopt a budget for operation during the ensuing biennium beginning July first. Such budget shall set forth the total cost of construction, maintenance and operation of gaging stations, the cost of engineering and clerical aid, and other necessary expenses excepting the salaries and personal expenses of the Commissioners. On odd-numbered years revisions of the budget shall be considered.
- B. It shall be the obligation of the Commissioners of the States of Montana and Wyoming to endeavor to secure from the Legislature of their respective states sufficient funds with which to meet the obligations of this Compact, except insofar as provided by the federal government.

Article V. Meetings

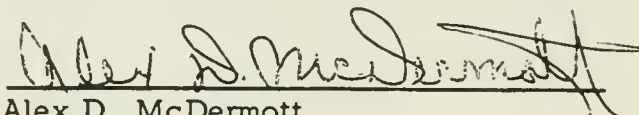
An annual meeting of the Commission shall be held on the third Tuesday of each November at some mutually agreeable point in the Yellowstone River Basin for consideration of the annual report for the water year ending the preceding September 30th, and for the transaction

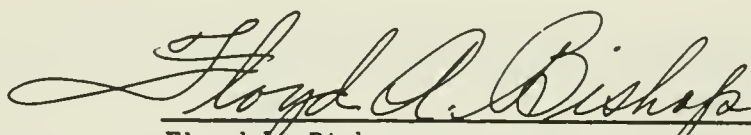
of such other business consistent with its authority; provided that by unanimous consent of the Commission the date and place of the annual meeting may be changed. Other meetings as may be deemed necessary shall be held at a time and place set by mutual agreement, for the transaction of any business consistent with its authority.

No action of the Commission shall be effective until approval by the Commissioners for the States of Wyoming and Montana.

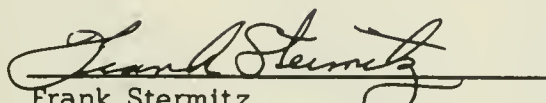
Article VI. Amendments, Revisions and Abrogations.

The Rules and Regulations of the Commission may be amended or revised by a unanimous vote at any meeting of the Commission.


Alex D. McDermott
Commissioner for Montana


Floyd A. Bishop
Commissioner for Wyoming

ATTESTED:


Frank Stermitz
Federal Representative

Adopted November 17, 1953
Amended November 16, 1959

MONTHLY SUMMARY OF DISCHARGE
Clarks Fork Yellowstone River at Edgar, Montana

Location.--Lat $45^{\circ}28'00''$, long $108^{\circ}50'30''$, in SE1/4 SE1/4 sec.23, T.4 S., R.23 E., on right bank just downstream from highway bridge, half a mile east of Edgar, 6 miles upstream from Rock Creek, and at mile 27.0.

Drainage area.--2,032 sq mi.

Records available.--July 1921 to September 1967. Prior to October 1956, published as Clarks Fork at Edgar. Monthly discharge only for some periods, published in WSP 1309. Records since January 1950 available in annual reports of Yellowstone River Compact Commission.

Gage.--Water-stage recorder. Altitude of gage is 3,440 ft (by barometer). Prior to Sept. 18, 1940, chain gage and Sept. 18, 1940, to Aug. 31, 1953, wire-weight gage, at same site and datum.

Average discharge.--46 years, 1,045 cfs (756,500 acre-ft per year).

Extremes.--Maximum discharge during year, 10,600 cfs June 23 (gage height, 8.61 ft); minimum daily, 280 cfs Dec. 29; minimum gage height, 1.56 ft Nov. 9.

1921-67: Maximum discharge observed, 10,900 cfs June 2, 1936 (gage height, 8.62 ft); minimum, 36 cfs Apr. 22, 1961.

Remarks.--Records good except those for winter period, which are poor. Upstream diversions for irrigation of about 41,500 acres, of which about 840 acres lie below the station. In addition, about 6,300 acres of land above station are irrigated by diversions from the adjoining Rock Creek basin. See next page for data on the flow of Whitehorse Canal and Clarks Fork Yellowstone River near mouth.

<u>Month</u>	<u>Second-foot days</u>	<u>Maximum</u>	<u>Minimum</u>	<u>Mean</u>	<u>Runoff in Acre-feet</u>
October 1966	14,574	610	415	470	28,910
November	14,392	615	400	480	28,550
December	13,133	580	280	424	26,050
January 1967	13,120	520	350	423	26,020
February	10,634	522	330	380	21,110
March	10,827	454	220	349	21,480
April	10,703	404	330	357	21,230
May	56,595	5,910	370	1,826	112,300
June	191,400	9,790	3,970	6,380	379,600
July	122,960	8,560	1,530	3,966	243,900
August	25,616	1,930	339	826	50,810
Sept. 1967	<u>14,858</u>	690	370	495	<u>29,470</u>
Water year 1966-67	498,812	9,790	220	1,367	989,430

MONTHLY SUMMARY OF DISCHARGE
Clarks Fork Yellowstone River at Edgar, Montana

Supplementary Data

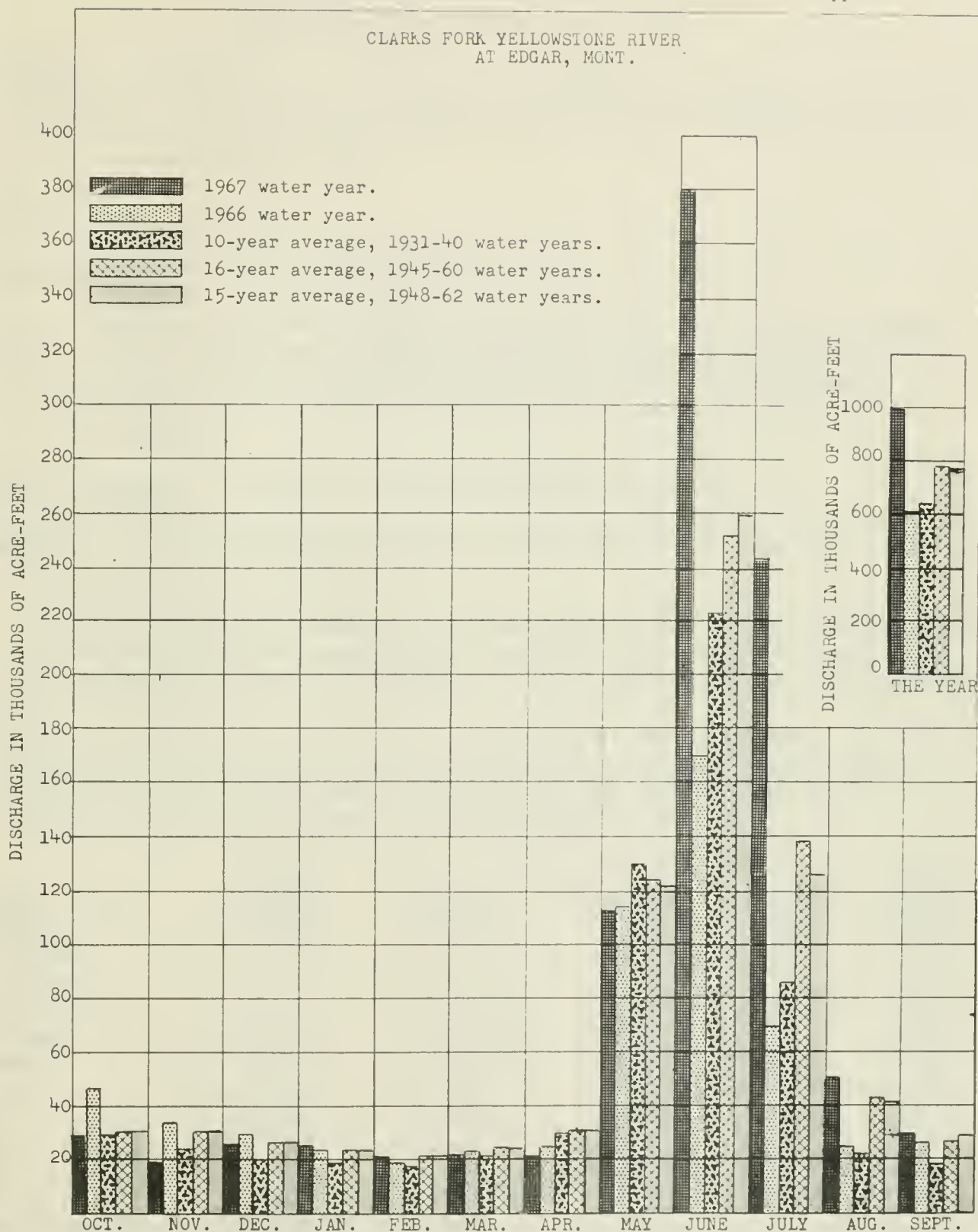
The Compact specified the official point of measurement of the Clarks Fork Yellowstone River shall be just above the mouth of Rock Creek about 6 miles downstream from the gaging station at Edgar. The known intervening diversion is the Whitehorse Canal which begins in SW1/4 sec.1, T.4 S., R.23 E., about 4 miles downstream from the gaging station. The canal serves about 1,000 acres. Based upon periodic discharge measurements of the diversion and information on canal operation, that seasonal diversion is estimated at about 12,000 acre-feet.

Periodic discharge measurements of the Clarks Fork Yellowstone River in SE1/4 sec.1, T.4 S., R.23 E., about half a mile downstream from the Whitehorse Canal diversion and the Whitehorse Canal are tabulated below. Concurrent discharge shown for the gaging station at Edgar is approximately adjusted for lag time. The indicated inflow may generally be return flow from irrigated lands served by Rock Creek water.

Discharge in cfs at selected points

<u>Date</u>	<u>Clarks Fork at Edgar</u>	<u>Whitehorse Canal</u>	<u>Clarks Fork at SE1/4 sec.1</u>	<u>Apparent inflow in reach</u>
Sept. 22, 1966	555	40.8	556	+42
Oct. 24	428	3.6	461	+37
Nov. 22	543	0	518	-25
Apr. 5, 1967	330	0	345	+15
Apr. 17	392	0	422	+30
May 15	481	0	493	+12
May 29	-	59.3	-	-
July 19	3,130*	49.3	3,020	-61
Aug. 15	687	40.9	740	+94
Sept. 19	635	23.2	688	+76
Oct. 19	659	17.3	660	+18

* Some uncertainty as to equivalent discharge due to large diurnal fluctuation.



Comparison of discharge during 1967 water year with 1966 water year and with average discharge for water years 1931-40, 1945-60 and 1948-62.

MONTHLY SUMMARY OF DISCHARGE
Little Bighorn River near Hardin, Montana

Location.--Lat $45^{\circ}44'10''$, long $107^{\circ}33'25''$, in NE1/4 NE1/4 sec.19, T.1 S., R.34 E., on left bank 50 ft downstream from bridge on Sarpy Road, a quarter of a mile upstream from terminal wasteway of Agency Canal, half a mile upstream from mouth, and 2-1/2 miles east of Hardin.

Drainage area.--1,294 sq mi.

Records available.--June 1953 to September 1967.

Gage.--Water-stage recorder. Altitude of gage is 2,890 ft (from topographic map). Prior to Oct. 6, 1953, wire-weight gage at site 0.4 mile downstream. Oct. 7, 1953, to May 6, 1963, water-stage recorder at site 0.3 mile downstream. May 6, 1963, to Nov. 6, 1963, staff gage at site 0.4 mile downstream. All at different datums.

Average discharge.--14 years, 238 cfs (172,300 acre-ft per year).

Extremes.--Maximum discharge during year, 4,040 cfs June 18 (gage height, 6.73 ft); minimum daily, 60 cfs Dec. 27, 28.

1953-67: Maximum discharge, 4,520 cfs Apr. 2, 1965; maximum gage height, 11.78 ft Mar. 20, 1960, site and datum then in use (backwater from ice); minimum discharge observed, 0.20 cfs Aug. 7, 1961, result of discharge measurement.

Remarks.--Records good except those for winter period, which are poor. Diversions for irrigation of about 17,000 acres above station. Flow partly regulated by Willow Creek Reservoir (capacity, 23,000 acre-ft). Figures of discharges given include flow of terminal wasteway of Agency Canal.

<u>Month</u>	<u>Second-foot days</u>	<u>Maximum</u>	<u>Minimum</u>	<u>Mean</u>	<u>Runoff in Acre-ft</u>
October 1966	3,386	134	82	109	6,720
November	3,727	170	80	124	7,390
December	3,076	130	60	99.2	6,100
January 1967	3,116	200	80	101	6,180
February	5,065	240	151	181	10,050
March	5,754	264	130	186	11,410
April	4,838	205	143	161	9,600
May	16,572	1,110	199	535	32,870
June	49,210	3,750	1,010	1,640	97,610
July	14,451	1,050	135	466	28,660
August	3,988	167	90	129	7,910
September 1967	<u>4,919</u>	286	86	164	<u>9,760</u>
Water year 1966-67	118,102	3,750	60	324	234,260

MONTHLY SUMMARY OF DISCHARGE
Bighorn River at Bighorn, Montana

Location.--Lat $46^{\circ}08'50''$, long $107^{\circ}28'00''$, in NE1/4 NE1/4 sec. 33, T.5 N., R.34 E., on right bank a quarter of a mile downstream from bridge on Interstate Highway 94, three-quarters of a mile upstream from mouth, 1 mile southwest of Bighorn, and 4 miles east of Custer.

Drainage area.--22,885 sq mi. At site used prior to Oct. 7, 1955, 22,410 sq mi.

Records available.--May 1945 to September 1967. Published as "near Custer," 1945-55. Records since January 1950 available in annual reports of Yellowstone River Compact Commission.

Gage.--Water-stage recorder. Altitude of gage is 2,690 ft (by barometer). May 11 to Dec. 6, 1945, wire-weight gage and Dec. 7, 1945, to Oct. 6, 1955, water-stage recorder, at site 4 miles upstream at different datum.

Average discharge.--22 years, 3,699 cfs (2,678,000 acre-ft per year), unadjusted.

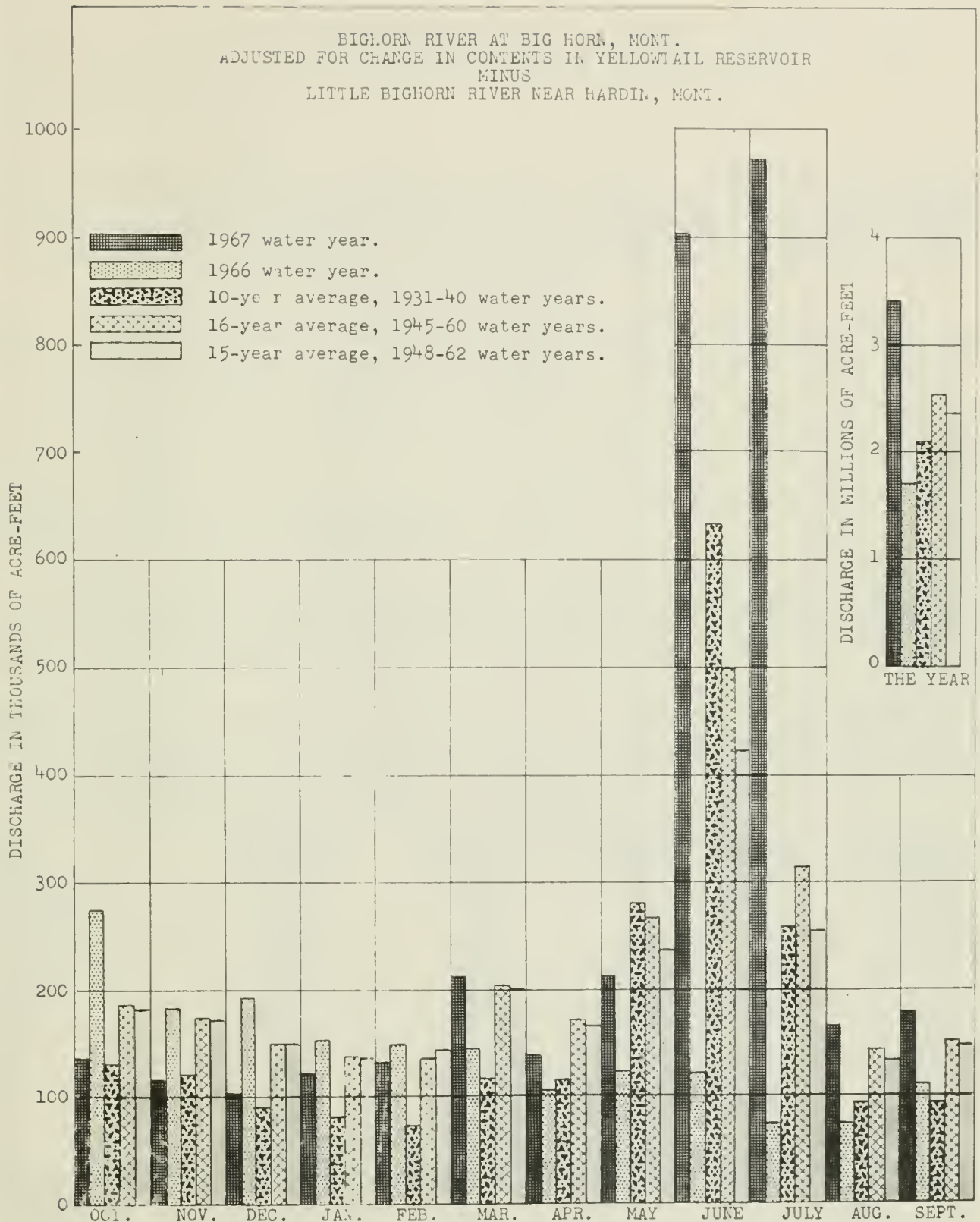
Extremes.--Maximum discharge during year, 25,300 cfs July 9 (gage height, 10.12 ft); minimum, 395 cfs Apr. 5 (gage height, 0.46 ft).

1945-67: Maximum discharge, 26,200 cfs June 24, 1947 (gage height, 8.79 ft, site and datum then in use), from rating curve extended above 12,500 cfs by logarithmic plotting; maximum gage height recorded, 14.21 ft Apr. 2, 1965 (ice jam); minimum discharge, about 275 cfs Nov. 15, 1959, result of freezeup; minimum daily, 500 cfs Mar. 5, 1966.

Remarks.--Records good except those for period of backwater from Yellowstone River, which are poor. Flow regulated by Yellowtail Reservoir beginning November 1965 (usable capacity, 1,356,000 acre-ft). Major regulation prior to November 1965 by 14 reservoirs in Wyoming and 1 in Montana with combined usable capacity of about 1,400,000 acre-ft (see Appendices C and D). Diversions for irrigation of about 465,000 acres above station.

Month	Second-foot days	Maximum	Minimum	Mean	Runoff in Acre-ft	Adjusted Runoff in Acre-ft*
Oct. 1966	45,205	2,260	945	1,458	89,660	142,300
Nov.	54,860	2,110	1,420	1,829	108,800	124,000
Dec.	75,800	3,690	1,750	2,445	150,300	109,500
Jan. 1967	61,090	2,140	1,850	1,971	121,200	129,100
Feb.	64,740	3,790	1,700	2,312	128,400	143,400
March	90,420	3,850	1,210	2,917	179,300	225,800
April	71,372	3,230	400	2,379	141,600	150,300
May	90,120	3,550	2,350	2,907	178,800	245,800
June	246,700	18,600	4,250	8,223	489,300	1,001,500
July	591,680	25,200	7,210	19,090	1,174,000	1,002,000
August	122,480	7,000	1,470	3,951	242,900	172,900
Sept. 1967	90,400	4,030	2,380	3,013	179,300	187,300
Water year						
1966-67	1,604,867	25,200	400	4,397	3,183,560	3,633,900

* Adjusted for change in contents in Yellowtail Reservoir



Comparison of discharge during 1967 water year with 1966 water year and with average discharge for water years 1931-40, 1945-60, and 1948-62.

MONTHLY SUMMARY OF DISCHARGE
Tongue River at Miles City, Montana

Location.--Lat $46^{\circ}21'$, long $105^{\circ}48'$, in SE1/4 sec.23, T.7 N., R.47 E., on right bank 4 miles south of Miles City and 8 miles upstream from mouth.

Drainage area.--5,379 sq mi.

Records available.--April 1938 to April 1942, April 1946 to September 1967. Published as "near Miles City" April 1938 to April 1942. Not equivalent to records published as "near Miles City" May 1929 to October 1932. Monthly discharge only for some periods, published in WSP 1309. Records since January 1950 available in annual report of Yellowstone River Compact Commission.

Gage.--Water-stage recorder. Altitude of gage is 2,370 ft (by barometer). April 1938 to April 1942, wire-weight gage at site 8 miles upstream at different datum. April 1946 to Sept. 30, 1963, at datum 1.00 ft higher.

Average discharge.--24 years (1938-41, 1946-67), 378 cfs (273,700 acre-ft per year).

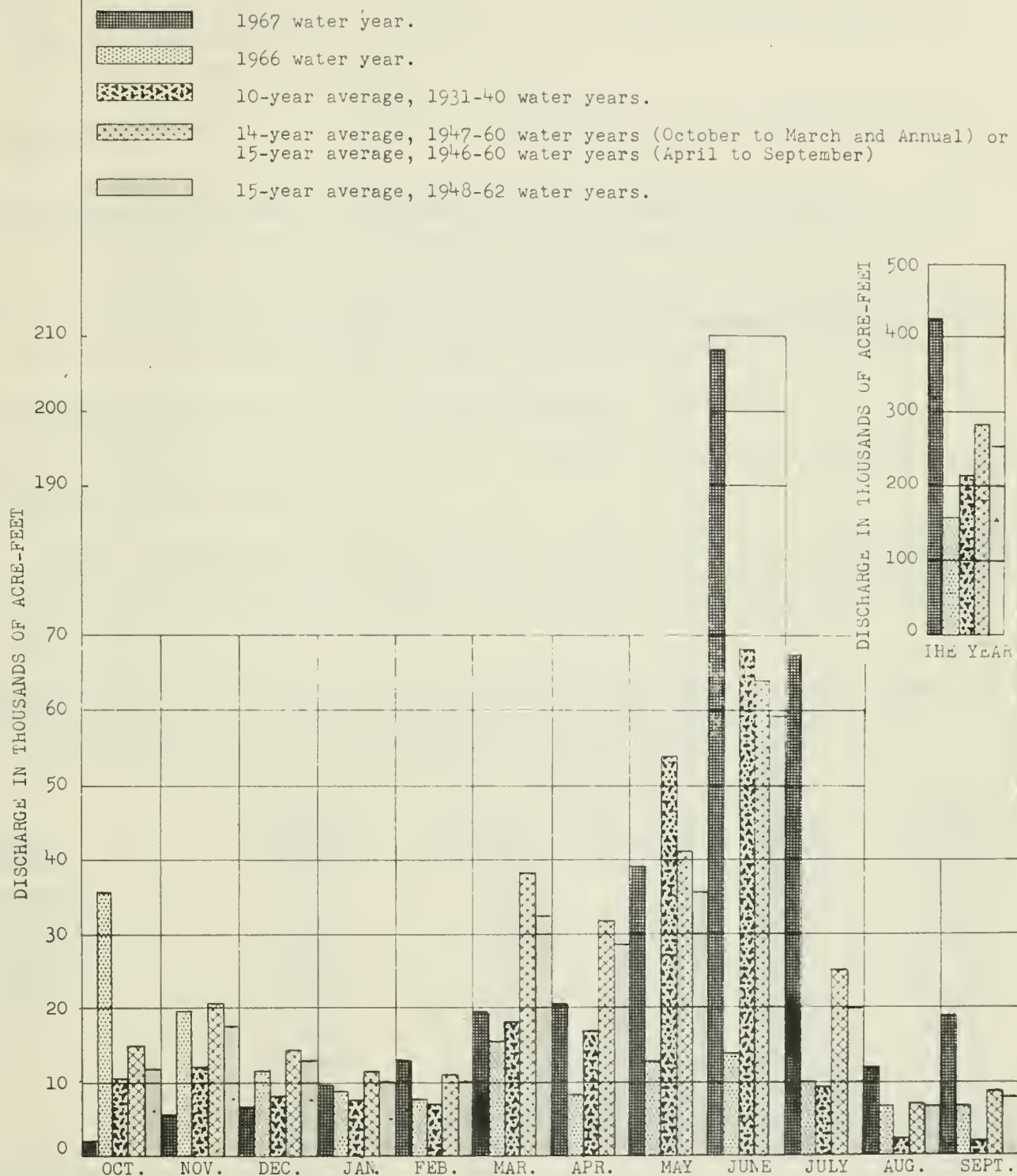
Extremes.--Maximum discharge during year, 7,990 cfs June 14 (gage height, 9.45 ft); minimum, 29 cfs Oct. 10 (gage height, 1.01 ft).

1938-42, 1946-67: Maximum discharge, 13,300 cfs June 15, 1962 (gage height 12.33 ft, present datum), from rating curve extended above 5,200 cfs on basis of float measurement; maximum gage height, 13.27 ft (present datum) Mar. 19, 1960 (ice jam); no flow July 9-19, Aug. 13, 14, Sept. 28, 1940.

Remarks.--Records good except those for periods of ice effect or no gage-height record, which are poor. Diversions for irrigation of about 90,000 acres above station. Flow regulated by Tongue River Reservoir (Appendix C) and many small reservoirs in Wyoming (combined capacity, about 15,000 acre-ft).

<u>Month</u>	<u>Second-foot days</u>	<u>Maximum</u>	<u>Minimum</u>	<u>Mean</u>	<u>Runoff in Acre-ft</u>
October 1966	1,083	40	31	34.9	2,150
November	2,844	125	50	94.8	5,640
December	3,205	140	65	103	6,360
January 1967	4,880	260	115	157	9,680
February	6,570	350	175	235	13,030
March	9,671	500	216	312	19,180
April	10,272	555	202	342	20,370
May	19,578	1,200	195	632	38,830
June	104,780	6,980	1,330	3,493	207,800
July	33,922	2,620	290	1,094	67,280
August	5,938	280	150	192	11,780
September 1967	<u>9,530</u>	1,090	148	318	<u>18,900</u>
Water year 1966-67	212,273	6,980	31	582	421,100

TONGUE RIVER AT MILES CITY, MONT.



Comparison of discharge during 1967 water year with 1966 water year and with average discharge for water years 1931-40, 1947-60 and 1948-62.

MONTHLY SUMMARY OF DISCHARGE
Powder River near Locate, Montana

Location.--Lat $46^{\circ}27'$, long $105^{\circ}19'$, in SW1/4 sec.14, T.8 N., R.51 E., on left bank 1-1/2 miles downstream from bridge on U.S. Highway 12 at present site of Locate (5 miles west of former site of Locate), 1.5 miles upstream from Locate Creek, and 25 miles east of Miles City.

Drainage area.--13,194 sq mi (revised). 13,189 sq mi at site used prior to Oct. 1, 1965.

Records available.--March 1938 to September 1967. Records since January 1950 available in annual reports of Yellowstone River Compact Commission.

Gage.--Water-stage recorder. Altitude of gage is 2,390 ft (by barometer). Prior to July 11, 1947, wire-weight gage at bridge 1-1/2 miles upstream and July 11, 1947, to Sept. 30, 1965, water-stage recorder at sites near bridge at different datum.

Average discharge.--29 years, 593 cfs (429,300 acre-ft per year).

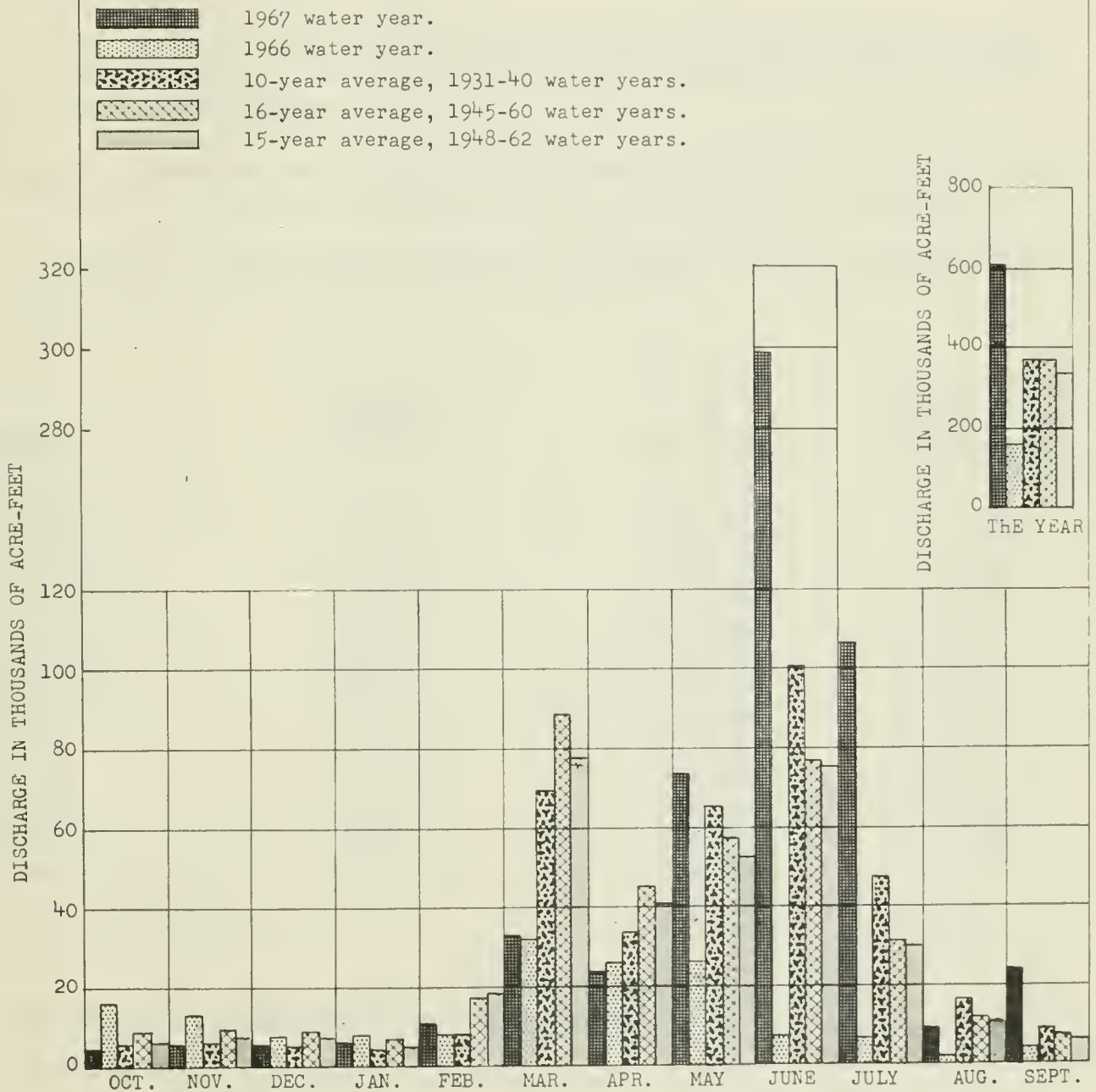
Extremes.--Maximum discharge during year, 13,500 cfs June 7 (gage height, 8.58 ft); minimum daily, 25 cfs Dec. 3, 4.

1938-67: Maximum discharge observed, 31,000 cfs Feb. 19, 1943 (gage height, 11.23 ft, site and datum then in use), from rating curve extended above 17,000 cfs; no flow Jan. 16 to Feb. 12, Feb. 22-24, 1950, July 27, Sept. 21-27, Oct. 1, 1960, Sept. 4-8, 1961.

Remarks.--Records good except those for winter period, which are poor. Diversions for irrigation of about 52,000 acres above station. Some regulation by three reservoirs in Wyoming with combined usable capacity of 36,800 acre-ft.

<u>Month</u>	<u>Second-foot days</u>	<u>Maximum</u>	<u>Minimum</u>	<u>Mean</u>	<u>Runoff in Acre-ft</u>
October 1966	2,394	118	36	77.2	4,750
November	2,567	142	30	85.6	5,090
December	2,940	200	25	94.8	5,830
January 1967	3,040	120	85	98.1	6,030
February	5,635	280	110	201	11,180
March	16,738	2,100	130	540	33,200
April	11,803	531	286	393	23,410
May	37,029	2,180	280	1,194	73,450
June	150,750	11,800	1,420	5,025	299,000
July	53,412	3,690	428	1,723	105,900
August	4,938	396	49	159	9,790
September 1967	<u>12,033</u>	1,160	46	401	<u>23,870</u>
Water year 1966-67	303,279	11,800	25	831	601,500

POWDER RIVER NEAR LOCATE, MONT.



Comparison of discharge for 1967 water year with 1966 water year and with average discharge for water years 1931-40, 1945-60 and 1948-62.

RESERVOIRS COMPLETED AFTER JANUARY 1, 1950

BOYSEN RESERVOIR

Water-stage recorder at dam on Wind River, about 21 miles south of Thermopolis, Wyoming. Reservoir formed by earth-fill dam, construction of which began in 1947. Storage began Oct. 11, 1951. Dead storage, 59,880 acre-ft at elevation 4,657.0 ft. Usable contents, 742,100 acre-ft at elevation 4,725.0 ft (top of gates). Crest of dam at elevation, 4,758 ft.

Records given herein represent usable contents. Water is used for irrigation and power development. Allocation for flood control provided. Data furnished by U.S. Bureau of Reclamation.

Extremes.--Maximum usable contents during year, 862,700 acre-ft July 7 (elevation, 4,730.84 ft); minimum, 439,900 acre-ft May 10 (elevation, 4,706.91 ft).

1953-67: Maximum usable contents, that of July 7, 1967; minimum, 189,800 acre ft Mar. 18, 19, 1956 (elevation, 4,684.18 ft).

<u>Month</u>	<u>Water-surface elevation in feet</u>	<u>*Contents in Acre-ft</u>	<u>Change in contents during month in Acre-ft</u>
September 30, 1966	4,712.63	524,900	
October 31	4,714.06	547,500	+ 22,600
November 30	4,714.22	550,100	+ 2,600
December 31	4,714.12	548,400	- 1,700
January 31, 1967	4,713.36	536,400	- 12,000
February 28	4,711.89	513,500	- 22,900
March 31	4,709.53	477,900	- 35,600
April 30	4,707.28	445,200	- 32,700
May 31	4,713.65	541,000	+ 95,800
June 30	4,729.99	844,400	+303,400
July 31	4,725.11	744,300	-100,100
August 31	4,722.52	694,700	- 49,600
September 30, 1967	4,721.88	682,700	- 12,000
Water year 1966-67			+157,800

* Does not include dead storage of 59,880 acre-ft.

RESERVOIRS COMPLETED AFTER JANUARY 1, 1950

ANCHOR RESERVOIR

Water-stage recorder at dam on South Fork Owl Creek, 31 miles west of Thermopolis, Wyoming. Reservoir formed by thin concrete arch dam, construction of which began in 1957. Closure of dam made Nov. 21, 1960. Temporary outlet at elevation 6,304.30 ft still in use. Lowest permanent outlet sill at elevation 6,343.75 ft, total contents, 148 acre-ft. Total contents, 17,420 acre-ft at upper active capacity level of 6,441 ft. Crest of dam at elevation 6,452.5 ft.

Records given in this report are total contents. Data furnished by U.S. Bureau of Reclamation.

<u>Month</u>	<u>Water-surface elevation in feet</u>	<u>*Contents in Acre-ft</u>	<u>Change in contents during month in Acre-ft</u>
September 30, 1966	6,304.30	0	
October 31	6,304.30	0	0
November 30	6,304.30	0	0
December 31	6,304.30	0	0
January 31, 1967	6,304.30	0	0
February 28	6,304.30	0	0
March 31	6,304.30	0	0
April 30	6,304.30	0	0
May 31	6,304.30	0	0
June 30	6,416.98	8,820	+ 8,820
July 31	6,376.56	1,510	- 7,310
August 31	6,304.30	0	- 1,510
September 30, 1967	6,304.30	0	0
Water year 1966-67			0

* Includes dead storage.

RESERVOIRS COMPLETED AFTER JANUARY 1, 1950

YELLOWTAIL RESERVOIR

Water-stage recorder at dam on Bighorn River, about 15 miles southwest of St. Xavier, Montana. Reservoir formed by concrete arch dam, construction of which began in 1961. Storage began Nov. 3, 1965. Dead storage, 18,970 acre-ft at elevation 3,296.5 ft. Usable contents, 1,356,000 acre-ft at elevation 3,657.0 ft. Crest of dam at elevation 3,660.0 ft.

Records given herein represent usable contents. Water is used for irrigation, power development and recreation. Allocation for flood control provided. Data furnished by U. S. Bureau of Reclamation.

Extremes.--Maximum usable contents during year, 1,346,000 acre-ft July 6 (elevation, 3,656.43 ft); minimum, 602,700 acre-ft Oct. 1 (elevation, 3,573.30 ft).

<u>Month</u>	<u>Water-surface elevation in feet</u>	<u>*Contents in Acre-ft</u>	<u>Change in contents during month in Acre-ft</u>
September 30, 1966	3,573.10	601,700	
October 31	3,583.28	654,300	+ 52,600
November 30	3,586.06	669,500	+ 15,200
December 31	3,578.45	628,700	- 40,800
January 31, 1967	3,579.97	636,600	+ 7,900
February 28	3,582.79	651,600	+ 15,000
March 31	3,591.11	698,100	+ 46,500
April 30	3,592.59	706,800	+ 8,700
May 31	3,603.24	773,800	+ 67,000
June 30	3,652.84	1,286,000	+512,200
July 31	3,641.30	1,114,000	-172,000
August 31	3,635.58	1,044,000	- 70,000
September 30, 1967	3,636.29	1,052,000	+ 8,000
Water year 1966-67			+450,300

*Does not include dead storage of 18,970 acre-ft.

RESERVOIRS IN EXISTENCE ON JANUARY 1, 1950

The extent, if any, of the use of reservoirs in this category which may be subject to Compact allocations was not determined. As a matter of hydrologic interest, the month-end contents in acre-feet of four reservoirs are given. The first three reservoirs are in the Bighorn River basin in Wyoming and data on contents were furnished by the U. S. Bureau of Reclamation. Tongue River Reservoir in Montana is operated under the supervision of the Montana State Water Conservation Board, which agency furnished operating data.

Contents in Acre-ft

<u>Month</u>	<u>a/ Bull Lake</u>	<u>b/ Pilot Butte Reservoir</u>	<u>c/ Buffalo Bill Reservoir</u>	<u>d/ Tongue River Reservoir</u>
September 30, 1966	72,480	7,000	280,600	10,240
October 31	74,640	700	238,800	<u>e/</u> 16,940
November 30	76,260	9,060	239,700	<u>e/</u> 23,840
December 31	74,520	11,540	233,600	<u>e/</u> 28,250
January 31, 1967	70,320	15,520	222,900	<u>e/</u> 30,390
February 28	67,230	17,870	203,800	<u>e/</u> 35,410
March 31	60,410	21,200	171,400	42,710
April 30	49,100	27,580	139,800	<u>e/</u> 40,730
May 31	71,880	28,600	201,700	<u>e/</u> 53,850
June 30	149,500	29,300	452,600	55,200
July 31	149,600	20,750	423,300	<u>e/</u> 45,790
August 31	131,500	7,800	366,900	<u>f/</u> 29,640
September 30, 1967	107,100	7,500	311,300	26,870
Change in Contents during year	+34,620	+ 500	+30,700	+16,630

a/ Total contents, from revised capacity table effective Oct. 1, 1965.

b/ Usable contents. Dead storage is 5,360 acre-ft.

c/ Total contents, from revised capacity table based on survey of 1959. Contents prior to October 1960 based on survey of 1941.

d/ Usable contents. Dead storage is 1,400 acre-ft. Contents based upon sedimentation surveys of October 1948.

e/ Contents interpolated on basis of once weekly readings of reservoir stage.

f/ First day of following month.

